

## IN THE CLAIMS:

The text of all pending claims, (including withdrawn claims) is set forth below. Cancelled and not entered claims are indicated with claim number and status only. The claims as listed below show added text with underlining and deleted text with ~~strikethrough~~. The status of each claim is indicated with one of (original), (currently amended), (cancelled), (withdrawn), (new), (previously presented), or (not entered).

11. (Currently Amended) A bidirectional signal processing method for the parallel transmission of digital transmit data streams, in regular and singular radio channels, of a multiple input-multiple output radio transmission system (MIMO system), having  $n_T$  transmit antennas and  $n_R$  receive antennas, that rank-adaptive matches the data transmission rate to the total currently available channel capacity while keeping constant the maximum transmit power  $P_{tot}$  as the sum of all subchannel powers  $P_i$ , where  $i = 1 \dots \min(n_T, n_R)$ , and that rank-adaptive matches the data transmission rate, in respect of a channel matrix  $\mathbf{H}$ , to the currently available channel capacity by varying and continuously adjusting the current channel behavior of  $n_d$  currently used subchannels and the spectral efficiency  $K$  of at least one selected coding and modulation method, comprising:

determining the channel matrix  $\mathbf{H}$  on the transmit and the receive side of the MIMO system according to  $\mathbf{y} = \mathbf{H}\mathbf{x} + \mathbf{n}$ , where  $\mathbf{y}$  = receive vector,  $\mathbf{x}$  = transmit vector, and  $\mathbf{n}$  = noise vector;

using a singular value decomposition  $\text{SVD}(\mathbf{H}) = \mathbf{U}\mathbf{D}\mathbf{V}^H$  of the known channel matrix  $\mathbf{H}$  with a maximum rank ( $n_T \times n_R$ ) on the transmit side and the receive side of the MIMO system to determine unitary transformation matrices  $\mathbf{U}$  and  $\mathbf{V}$  and a diagonal matrix  $\mathbf{D}$  containing the ordered singular values  $\sqrt{\lambda_i}$  derived from the eigenvalues  $\lambda_i$  of the subchannels on the left main diagonal;

modifying the transmit data vector  $\mathbf{x}$  on the transmit side of the MIMO system by means

of a linear matrix-vector multiplication according to  $\mathbf{x} = \frac{1}{\gamma} \mathbf{V} \mathbf{Q} \mathbf{d}$ , where  $\gamma = \sqrt{\sum_{i=1}^{n_d} \frac{P_i}{P_{tot}}} =$

amplification factor for limiting the total transmit power  $P_{tot}$ , where  $\mathbf{Q}$  = diagonal transmit matrix containing the values  $\sqrt{P_i}$  on the left main diagonal, and where  $\mathbf{d}$  = current transmit data vector containing the variable length  $n_d \leq \min(n_T, n_R)$  for the support of  $n_d$  subchannels for the parallel transmission of the transmit data streams;

multiplying the currently received transmit data vector  $\mathbf{d}'$  on the receive side of the MIMO

system by  $\gamma \mathbf{U}^H$ , from which it follows  $\mathbf{d}^* = \gamma \mathbf{U}^H \mathbf{y} = \mathbf{D} \cdot \mathbf{Q} \cdot \mathbf{d} + \gamma \mathbf{U}^H \mathbf{n}$ ;

determining the  $n_d$  components  $d_k^*$  of the currently received and modified transmit data

vector  $\mathbf{d}^*$  according to  $d_k^* = \sqrt{\lambda_k \cdot P_k} \cdot d_k + \gamma \cdot \tilde{n}_k$   $d_k^* = \sqrt{\lambda_k \cdot P_k} \cdot d_k + \gamma \cdot \tilde{n}_k$ , where  $k = 1 \dots n_d$ ;

selecting the subchannel powers  $P_i$  with either:

a) optimal rank-adaptive support for all subchannels  $P_i > 0$  based on the water-

filling principle WF according to  $P_i = \left( \mu - \frac{\sigma_n^2}{\lambda_i} \right)^+$ , where  $(a)^+ = 0$  for  $a = 0$  and  $(a)^+ = a$  for  $a \neq 0$ ,

where  $\mu$  = fill factor, which is chosen so that  $\sum_{i=1}^{n_d} P_i = P_{tot} \Rightarrow \gamma = 1$ , and where  $\sigma_n^2$  = noise power

at the receiver, which yields the number  $n_d$  of the currently usable subchannels for a modification

of the current transmit data vector  $\mathbf{d}$  according to  $n_d = |\{i : P_i > 0\}|$  and which yields a variable

signal-to-noise ratio according to  $SNR_k^{WF} = \frac{\lambda_i \cdot P_i}{\sigma_n^2}$ , or

b) suboptimal rank-adaptive support for all subchannels based on the adaptive

channel inversion principle ACI according to  $\mathbf{DQ} = \mathbf{I}$ , where  $\mathbf{I}$  = unity matrix for a complete

interference cancellation according to  $P_i = \frac{1}{\lambda_i}$ , where the number  $n_d$  of the currently usable

subchannels is selected for a modification of the current transmit data vector  $\mathbf{d}$  such that the spectral efficiency  $K$  of the transmission is maximized and a constant signal-to-noise ratio is

produced according to  $SNR_k^{ACI} = \frac{P_{tot}}{\sigma^2 \sum_{i=1}^{n_d} \frac{1}{\lambda_i}}$ ; and

selecting an optimal coding and modulation method based on a determined signal-to-

noise ratio  $SNR_k^{WF}$  or  $SNR_k^{ACI}$  with a specific bit error rate, BER, to be complied with, where in

case a) of the optimal rank-adaptive channel support, the optimal coding and modulation method

is selected in each case for each of the  $n_d$  active subchannels or in case b) of the suboptimal

rank-adaptive channel support, a common coding and modulation method is selected for all  $n_d$  active subchannels.

12. (Previously Presented) The bidirectional signal processing method of claim 11, further comprising selecting the optimal coding and modulation method by comparing the

determined values  $SNR_k^{WF}$  for the currently activated subchannels with  $SNR$  values required for a specific coding and modulation method enabling the specified bit error rate, BER, to be complied with using the currently available subchannel powers  $P_i$ .

13. (Previously Presented) The bidirectional signal processing method of claim 11, further comprising selecting the optimal coding and modulation method by comparing the determined value  $SNR_k^{ACI}$  for all currently activated subchannels with an  $SNR$  value required for a specific coding and modulation method enabling the specified bit error rate, BER, to be complied with using the maximum transmit power  $P_{tot}$ , including a power increase through the support for the currently activated subchannels on the basis of the current transmitter-side singular value decomposition.

14. (Previously Presented) The bidirectional signal processing method of claim 11, further comprising transmitting the current number,  $n_d$ , of activated subchannels, as determined on the transmit side, to the receive side via a signaling channel.

15. (Previously Presented) The bidirectional signal processing method of claim 11, further comprising front-end compensating, on the transmit side, of statistical fluctuations in the maximum transmit power of the MIMO system.

16. (Previously Presented) The bidirectional signal processing method of claim 11, further comprising selecting a transmit covariance matrix  $\mathbf{Q} = \mathbf{D}^{-1}$  for matching all currently active subchannels to an identical performance, where  $\gamma = \sqrt{\sum_{i=1}^{n_d} \frac{1}{\lambda_i}}$ .

17. (Previously Presented) The bidirectional signal processing method of claim 11, further comprising a MIMO system which operates according to the Time Division Duplex transmission method.

18. (Previously Presented) The bidirectional signal processing method of claim 11, further comprising a MIMO system in which the channel estimation in the uplink is reused for the signal processing in the downlink and vice versa.

19. (Previously Presented) The bidirectional signal processing method of claim 11, further comprising a source commonly coded and modulated on the transmitter side for all the data streams to be transmitted in parallel.

20. (Previously Presented) The bidirectional signal processing method of claim 11, further comprising decomposing the transmit and receive signal by an OFDM method into a plurality of subcarrier signals, with the bidirectional signal processing method being performed for each subcarrier signal.

21. (Previously Presented) The bidirectional signal processing method of claim 13, further comprising transmitting the current number,  $n_d$ , of activated subchannels, as determined on the transmit side, to the receive side via a signaling channel.

22. (Previously Presented) The bidirectional signal processing method of claim 21, further comprising front-end compensating, on the transmit side, of statistical fluctuations in the maximum transmit power of the MIMO system.

23. (Previously Presented) The bidirectional signal processing method of claim 22, further comprising selecting a transmit covariance matrix  $\mathbf{Q} = \mathbf{D}^{-1}$  for matching all currently active subchannels to an identical performance, where  $\gamma = \sqrt{\sum_{i=1}^{n_d} \frac{1}{\lambda_i}}$ .

24. (Previously Presented) The bidirectional signal processing method of claim 23, further comprising a MIMO system which operates according to the Time Division Duplex transmission method.

25. (Previously Presented) The bidirectional signal processing method of claim 24, further comprising a MIMO system in which the channel estimation in the uplink is reused for the signal processing in the downlink and vice versa.

26. (Previously Presented) The bidirectional signal processing method of claim 25, further comprising a source commonly coded and modulated on the transmitter side for all the data streams to be transmitted in parallel.

27. (Previously Presented) The bidirectional signal processing method of claim 26, further comprising decomposing the transmit and receive signal by an OFDM method into a plurality of subcarrier signals, with the bidirectional signal processing method being performed for each subcarrier signal.

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